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INDIAN TEA ASSOCIATION

THE USE OF E. C. IN FACTORIES IN THEORY AND PRACTICE

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CALCUTTA
PRINTED AT THE CATHOLIC ORPHAN PRESS
3 & 4 PORTUGUESE CHURCH STREET
1934

THE USE OF E. C. (ELECTROLYTIC CHLORINE) IN FACTORIES IN THEORY AND PRACTICE.

Introduction

At the suggestion of the London Committee of the Indian Tea Association, this monograph on the use of E. C. in tea factories is being published in view of the confusion of thought which has recently arisen on the subject.

When investigations on bacterial infection were commenced in 1929, there was a general idea that infection was only occurring if the teas were tainted. Early research however showed that a bacterial infection could give rise to dull infused leaf and soft liquors, without the appearance of a taint. It was thus realised that bacterial infection might be far more widespread than had hitherto been imagined; later work has confirmed this point.

The lines of research were at first influenced by the prevailing idea that infections arose largely on the fermenting floor, and this section of the factory received the earliest attention. Subsequent investigations have indicated that rolling room floors have in the past been a greater source of infection than fermenting floors, but it is still recognised that an unclean fermenting floor is undesirable and may have an effect on infused leaf and liquors.

A review of general factory infections has been published separately, but it will be necessary to recapitulate certain of the factors concerned in bacterial infection in order to secure a logical view of the object of E. C. for cleaning fermenting floors.

Bacterial development on the fermenting floor

When rolled leaf is laid on a fermenting floor some of the juice on the surface of the leaf is deposited on the floor. The ensuing processes of oxidation or condensation of the tannin result in a portion of this deposit becoming insoluble in water, so that it cannot be removed by simple washing at the end of the

period of manufacture. The deposit is a suitable medium for the development of bacteria.

In tropical climates it may be accepted as a general fact that large numbers of bacteria will be found wherever organic matter and moisture are present together. Such conditions obtain on the majority of fermenting floors, and the development of bacteria is a natural result.

Bacteria may be introduced into a factory in many ways, *e.g.*, through the use of dirty water or by the factory labour, but even when this type of contamination is absent bacterial infection must be expected. Leaf brought in fresh from the field carries a certain number of bacteria, which may vary from a few hundred to several hundred thousand per gram, depending on the season and on whether the leaf is wet or dry. The average infection on fresh leaf is about 50,000 bacteria per gram in the monsoon, and this number seems to be insufficient to affect quality as at present understood.

Bacterial development on fresh or withered leaf is negligible unless the leaf is wet, absence of moisture and shortage of food supply restricting bacterial growth. When, however, the leaf is rolled and its surface coated with juice, an adequate supply of both food and moisture is ensured, and bacterial development commences, slowly at first but increasing rapidly after the first few hours. A typical count on fermenting leaf gives the following figures.

Bacteria at start of fermentation	...	490,000	per	gram
Bacteria after 4 hours fermentation	...	720,000	,,	,,
,, 8 ,,	...	10,000,000	,,	,,
,, 12 ,,	...	302,000,000	,,	,,
,, 20 ,,	...	6,200,000,000	,,	,,
,, 24 ,,	...	10,500,000,000	,,	,,

It will thus be realised that juice freshly deposited on a fermenting floor may be highly infected with bacteria within a few hours of its deposition, and that all floors which are not entirely free from this juice are potentially capable of affecting the fermenting leaf.

BACTERIAL EFFECTS ON THE FERMENTING FLOOR

Two main effects of bacteria on the fermenting floor are now recognised :—A direct effect which occurs when the bacteria themselves enter the mass of fermenting leaf, or act on the leaf in contact with the floor, and an indirect effect caused when the bacteria, in decomposing the juice residues already on the floor, liberate volatile substances such as ammonia, which rise through the bed of leaf.

The direct effect is most likely to occur when fermenting floors are kept wet, but in all probability takes place to a small extent even on dry floors, only the particles of leaf in direct contact with the floor being affected. The indirect effect may occur on any floor which is not completely free from juice deposits, but appears to be most intense when the floor carries a heavy layer of moist residues on the surface, or when a porous floor has been penetrated by tea juice.

There are many different species of bacteria which occur on fresh leaf and in the factory. Evidence also points to the fact that the same bacteria under different conditions of growth may have a variable effect on the fermenting leaf. It is thus possible for good teas to be produced for a time on an infected floor, but such a floor may suddenly begin to affect the leaf, although no visible change in its condition has taken place.

CONTROL OF BACTERIAL GROWTH

With a dirty floor then, there is always a possibility of teas being affected by the action of bacteria. The three most essential factors for bacterial growth are heat, moisture, and food, and by eliminating one or more of these factors, bacterial action can be controlled. Reasonably complete control can be obtained by reducing the temperature to below 60° F., but the bacteria will not be entirely suppressed until 45° F is reached. Such conditions are impracticable in low elevation factories, and in any case a temperature of 45°F would retard fermentation to an unmanageable extent. Control by elimination of moisture can be

partially effected by avoiding the use of water during manufacture. The leaf itself is moist, however, so that control of bacteria by this method must necessarily be incomplete. Removal of the bacterial food supply is the only possibility remaining, and this was the point which led to the introduction of Electrolytic Chlorine to assist in the removal of juice deposits from fermenting floors. Even this method is not fully satisfactory and cement floors require cleaning at fairly frequent intervals to remove the juice which accumulates during a few days manufacture.

EARLIER ATTEMPTS AT CONTROLLING FERMENTING FLOOR INFECTION

The recognition that taints in tea might arise as a result of fermenting on a dirty floor has in the past given rise to several methods of treating fermenting floors, steaming, frequent washing with water, and washing with permanganate of potash solution having been in use for many years. None of these methods is fully satisfactory since they all fail in the primary consideration—the removal of deposited juice.

Steaming aims primarily at sterilising the floor. The figures given earlier in this leaflet however, show that if any bacteria are left alive after the treatment, they will speedily reinfect the whole floor, being assisted in this by the moist condition of the deposits. In any case the floor will be reinfected immediately the next day's manufacture commences. Daily steaming is doubtless preferable to nothing, but it cannot be considered as a complete treatment, unless the steam is used to soften the deposit preparatory to its removal by scrubbing with sand and water.

The system of constant washing during manufacture appears to be based on a misconception. A dirty fermenting floor often gives off unpleasant odours, and, with the idea of counteracting this tendency, the floor is sometimes washed down as each bed of leaf is lifted. The odours are not however due to the bacteria themselves but to the products of bacterial action on the dirt on the floor. The substances produced are usually soluble in water,

and constant washing may have the effect of sweetening the floor for a short time, but the presence of moisture stimulates the bacteria and results in increased activity.

Ideally the use of permanganate of potash was a step in the right direction, but actually it was of less value than was assumed owing to the weak nature of the reagent employed. Permanganate of potash is an oxidising agent and its use was intended to oxidise and dissolve the dirt on the floor, at the same time exerting a sterilising action on the bacteria. A pale pink solution was usually employed, of the order of 1 ounce permanganate of potash in up to 100 gallons of water. A solution of this strength has practically no action on the organic matter on fermenting floors. Even at a concentration of 1 ounce per gallon, its effect on floor residues is slight and bacteria are only partly destroyed. The following figures demonstrate the latter point.

EFFECT OF PERMANGANATE (1 OUNCE PER GALLON) ON BACTERIA

Control	...	740,000,000 bacteria.
Permanganate allowed to act for 5 minutes	...	193,000,000 ,,
Permanganate allowed to act for 30 minutes	...	100,000,000 ,,

It is very doubtful if permanganate of potash solution is any better than plain water. Where good results have in the past been been obtained from this treatment, they can be ascribed to the drastic method of application, the vigorous scrubbing with sand and water removing the juice residues by mechanical rather than by chemical means.

ELECTROLYTIC CHLORINE

Electrolytic Chlorine was adopted after extensive tests on account of its cheapness, its high activity as a solvent of organic matter, and the fact that its odour is destroyed by contact with organic matter or fresh tea juice.

The latter point has caused some concern in the industry since at first it might be thought that the strong odour of chlorine

might taint the teas. A brief consideration of the chemistry of the reactions taking place between electrolytic chlorine and organic matter will show, however, that no taint is possible.

The active principle of electrolytic chlorine is sodium hypochlorite, which reacts with atmospheric carbon dioxide or other acids to give hypochlorous acid, an unstable substance which rapidly decomposes, yielding free chlorine.

The chlorine so formed is the primary oxidising agent, but its effect depends on its interaction with water. The process is complicated and goes through a number of intermediate stages, but the final result may be expressed by the equation :

Cl_2	+	H_2O	=	$2HCl$	+	O
(chlorine)		(water)		(hydrochloric acid)		(active oxygen)

The oxygen is liberated in the atomic, or active state, and it is the effect of these atoms which brings about the destruction of organic matter.

The above reaction is not instantaneous but proceeds as the oxygen is used up. In the presence of a readily oxidisable substance such as tea juice, the reaction is completed rapidly, and it is to be noted that at the end of the process no free chlorine is present.

Chlorine being a strong oxidising agent cannot exist in contact with tea juice. In support of this statement, it was frequently observed that although a strong chlorine odour is noticeable when E. C. is first applied to fermenting floors, this odour completely disappears within a few minutes. The residual hydrochloric acid which is formed during the reaction is very soluble in water and is completely removed by the thorough washing which should always follow E. C. treatment of a fermenting floor. If considerable quantities of hydrochloric acid were left on the floor, a thin bright liquor might result.

The complete utilisation of free chlorine by tea house residues has been confirmed by laboratory tests, fermenting floor scrapings being left in contact with different amounts of E. C.

for 30 minutes, and the residual chlorine determined at the end of this period.

DESTRUCTION OF FREE CHLORINE BY TEA HOUSE SCRAPINGS

Amount of chlorine added to 0·2 gms. organic matter	Amount of chlorine remaining after 30 minutes.
0·1185 gms.	0·0035 gms.
0·0592 „	0·0007 gms.
0·0237 „	nil
0·0118 „	nil

The residual chlorine was estimated by a method which gives a definite positive reaction with 0.000018 gms. free chlorine. The organic matter from the tea house can thus destroy the whole of the free chlorine in E. C. within 30 minutes, if the amount of chlorine is not more than 1/10 of the amount of the organic matter. Further tests have shown that over a period of 24 hours such organic matter can destroy approximately its own weight of free chlorine.

Actual determinations have shown that a floor from which only a thin film of dried juice can be scraped will carry about 8 grams of this material per square foot. A gallon of diluted E. C. solution, containing 1 ounce of 5% E. C., *i.e.*, 1.35 gms. free chlorine, will cover roughly 20 square feet of floor. Hence under factory conditions 1.35 gms. of chlorine will come in contact with at least 160 gms. organic matter, 13.5 gms. of which is sufficient to destroy the whole of the free chlorine in 30 minutes. In practise, then, there is at least ten times the amount of dirt necessary to destroy the free chlorine, and there can be no question of chlorine subsequently tainting the teas. Proof of this point is given in the following experiments. At Garden 9 a portion of the fermenting floor was cleaned with E. C. and immediately after washing, rolled leaf was put down on the cleaned and uncleaned floor. A tasters report on the two samples was :

A. From floor cleaned with E. C.
B. From ordinary floor.

"As regards liquors, neither show any trace of foreign taint, they possess briskness with good strength and colour and we give preference to the sample marked A which has more quality."

On Garden 10 to remove a "fishy" taint it was found necessary to clean the floor each night using excessive amounts of E. C. On some occasions, full strength E. C. was employed the floor being bleached white and all organic matter destroyed. The subsequent washing was evidently sufficient to remove all traces of the treatment since a taster reporting on the teas made at this time writes :

"I certainly did not find a character on (Garden 10) teas which could be attributed to the use of E. C."

METHOD OF USE OF ELECTROLYTIC CHLORINE

The figures given above for the ratio E. C. : organic matter have a close bearing on the method of using E. C. for cleaning fermenting floors. Under normal conditions the amount of E. C. used is not sufficient to destroy the whole of the residues on a fermenting floor. Washing a floor with E. C. is therefore of little value and may actually be harmful as will be shown later. This fact was recognised when the original experiments with E. C. were being made, and the E. C. system of cleaning floors was put forward with this in mind.

The original method requires the addition of four ounces of 1% E. C. or one ounce of 4-5% E. C. to a gallon of water which has previously been heated to boiling point. The floor to be cleaned is thoroughly scrubbed with this solution, the liquid being poured on the floor in small quantities as the work proceeds. Freshly deposited juice is quickly removed, the solution taking on a brown colour, but with old deposits, the use of sand and coconut husks is usually necessary.

A modification of this method was introduced by adding half an ounce of battery acid to four gallons of water, E. C. being used in the same proportion as before, the solution being applied cold. The function of the acid will be understood on reference

to the paragraph on the chemistry of the reaction (p. 6). The liberation of chlorine from the hypochlorite depends on interaction with atmospheric carbon dioxide and this tends to slow down the rate of reaction. By adding sufficient acid to liberate the chlorine immediately, the initial stage of the reaction becomes almost instantaneous. Furthermore E. C. is an alkaline solution and the use of alkalies on fermenting floors is not altogether desirable. The amount of battery acid used in the acidified E. C. treatment is calculated to neutralise the free alkali of the E. C., giving a solution approximating to neutrality.

When the whole of the residues have been detached from the floor, a thorough washing completes the treatment. It is important to remove the whole of the material which has been detached, since this is still susceptible to bacterial infection and if left on the floor will nullify the effects of the treatment.

It is equally important to remove all traces of the cleaning solution, since traces of free alkali might lead to blackening of leaf subsequently laid on the floor.

The chief requirements of the process are:

(1) Recognition of the fact that E. C. is used, not as a sterilising agent, but to assist in *cleaning* a floor.

(2) Complete removal of the film of tea juice.

(3) Thorough washing of the floor after treatment.

(4) The use of E. C. on floors which can be *cleaned*. Discussion of this point is relegated to a later paragraph.

Where these points have been closely followed, the use of E. C. has been accompanied by an improvement in the teas of a number of gardens. The following are typical examples:

On Garden 41, E. C. was used throughout the season and the teas were reported to be the best the garden had produced, colours being good throughout the season. In the following

year, E. C. was rarely used, and the teas were stated to have fallen off considerably, colours being generally poor.

On Garden 13, a high elevation Darjeeling estate, liquors were poor and infusions dull. An experiment was carried out with half the fermenting floor cleaned with E. C. and half uncleaned. A London broker's report on the samples was :

> "We have tasted with interest the samples under review, representing manufacture of leaf spread on the fermenting floor before and after cleaning, as recommended by the Scientific Officer at Tocklai. The difference in favour of the teas representing the manufacture of leaf spread after cleaning is most marked, the liquors have a tendency to be light, but are brighter in description and have more quality and flavour, while the infused leaf is brighter in colour."

At Garden 5 the fermenting floor was cleaned weekly during 1931. The Manager reported that his infused leaf was brighter, and liquors brisker than for a number of years. A noticeable feature of this garden was that the Rains teas, when E. C. was in use, fetched higher prices than the second flush invoices.

The Manager of Garden 12 wrote :

> "The treatment completely altered the character of the teas. After treatment, colours are bright, and liquors hard, brisk and bright. A peculiar taint which was almost regarded as a garden character, has disappeared."

Garden 16 reports :

> "It is a fact that infusions are invariably brighter and a better colour on the day following disinfection, and I am not at all sure that this should not be done between every manufacture and fermentation."

Garden 30, selling on the London Market, reports :

"E. C. was used weekly from September 15th., 1930. There was a steady improvement in valuations from the middle of September onwards and high prices were obtained for Autumnal teas."

The Manager of Garden 14 writes :

"Our prices last year (1931) were 0.92 pence below the season before, against an average drop in the market for Assam of 2 pence; so the E. C. did help. I found the E. C. cleaning would be necessary on our fermenting floor two or three times a week. We could seldom manage to do it twice a week, usually once. The colours improved for two or three days after the treatment, then went off again."

This garden has since adopted fermentation on racks owing to the difficulty experienced in keeping the fermenting floor clean.

In a recent experiment carried out in the presence of a taster, teas fermented on a floor immediately after cleaning with E. C. showed brighter infused leaf and more pungent liquors than teas fermented on the uncleaned floor (garden 47).

A Calcutta Agency House reports :

"We have had instances where an improvement in quality can, as far as we have been able to ascertain, be attributed to nothing less than the correct use of Electrolytic Chlorine."

It is thus evident that E. C., correctly applied has proved itself to be a valuable means of eliminating bacterial infection from the fermenting floor, and of improving the teas where these were exhibiting defects of a bacterial origin.

DEFECTS WITH THE E. C. TREATMENT

In common with all processes of tea manufacture, E. C. can be misused and when this occurs, the results may not be satisfactory. The amount of E. C. used and the conditions of its

application are such that the chlorine itself cannot affect the teas to any appreciable extent. Any result, either good or bad, can only be attributed to its effect on the bacterial flora of the fermenting floor. An exception is, of course, when leaf is laid on a floor from which the E. C. solution has not been removed. Free alkali may then produce dark leaf.

It is first necessary to dispose of instances where defects attributed to E. C. must actually be ascribed to other causes.

CHLORINE TAINTS IN TEA

A case has been unofficially reported in which a taster claimed that he had detected a chlorine taste in a tea a year after manufacture. Reference to the chemical theory given earlier shows that chlorine cannot exist in contact with residues on the floor or with tea juice. To carry the argument still further the following figures are put forward.

E. C. is normally used once a week at the rate of 1 gallon (containing 1.35 gms. free chlorine) to 20 square feet of floor. This represents $\frac{1}{400}$ oz. chlorine per square foot. The amount of leaf spread on a square foot of the floor may amount to 5 lbs. per day, or 30 lbs. in a six-day week. Omitting the fact that the whole of the free chlorine is destroyed by the dirt present and the residues washed off the floor before any leaf is put down, the ratio of chlorine used to leaf fermented works out at 1 : 190,000 or about one part of chlorine to 63,000 parts of fired tea.

The tasters infusion contains a little less than 3 gms. of tea in 120 cc of water. Thus if the E. C. normally used for cleaning the fermenting floor were actually mixed with the week's outturn of tea, and if the chlorine were not destroyed by the constituents of the leaf, the concentration of chlorine in the tasters infusion would be approximately 1 part in 2,500,000 parts of liquor. Such an amount is permitted by Public Health authorities for water sterilisation as being tasteless.

A taste of chlorine in finished tea is therefore a physiological and chemical impossibility, and can only be attributed to the fact that other tastes may give a reaction similar to that of chlorine

on a delicate palate. Similarly the presence of an "earthy" taint does not indicate that the teas have been contaminated with earth, and a "baky" taint may be caused by bacteria without any suggestion of high firing. In both these instances however, the reaction on the palate suggests a connection with a well-known taste or smell. The same must be the case when a so-called "chlorine" taste is detected in tea.

THE KEEPING POWERS OF TEA

A suggestion has been put forward that the use of E. C. can render teas likely to "go off" after packing. No scientific theory can be devised to uphold this statement which would not apply equally well to teas manufactured under aseptic conditions without the use of E. C. Garden 6 may be quoted in this respect where the teas suffered no infection during manufacture and E. C. was used to clean a tiled fermenting floor. The second flush teas from this garden fetched high prices on the London market in 1931, selling well above valuation. As a further example may be quoted teas from the Tocklai factory where E. C. was used in quantity throughout the year. The teas in question were kept for some months in stoppered bottles, and samples were subsequently submitted to a London broker who reported "They are all exceptionally good teas and equal to anything we have seen from Assam this year".

One definite reason is known which causes teas to go off on keeping, and that is high moisture content. Where teas are known to have gone off a careful examination of the facts would probably show that the falling off in character on keeping was due to well recognised causes.

DESTRUCTION OF FLOORS BY ACID E. C.

A point has recently been raised that the use of acid E. C. had led to the destruction of fermenting floors. At Tocklai excessive amounts of acid E. C. have been used since 1930, to such an extent that the fermenting floor has still the appearance of new cement. No sign of any damage to the cement surface can be detected, which is to be expected since the amount of acid

used, *viz.*, ½ ounce battery acid to 4 ozs. of 5% E. C. in 4 gallons of water, was calculated to be just sufficient to neutralise the free alkalinity of the E. C., the solution being approximately neutral when applied. It is possible that in some cases, excessive amounts of acid have been used, and this may have attacked the floor, although double the amount of acid advised would only give a concentration of 1 part free acid in 4,000 parts water. The more probable explanation is that the intensive scrubbing methods required, when applied to floors in poor condition, have destroyed the surface by friction. Where this has occurred, a clear indication is obtained that the floor was in need of renewal. No case is known to us of a good floor suffering damage as a result of correct treatment with acid E. C.

Omitting the three instances given above, cases have been reported where the use of E. C. has been followed by a darkening in the colour of the infused leaf. Such cases are rare and the cause is not fully clear from a scientific point of view.

Where dull colours have followed the use of E. C., one can only postulate the following theory :

The action of a strong oxidising agent of this type results in the partial decomposition of the organic matter on the floor. It is suggested that this partially decomposed material may support bacterial growth better than the original deposit. Decomposition of the nitrogenous matter in the residues may also accelerate the production of ammonia under bacterial action.

In any case the effect is not directly due to the use of E. C. but to its incorrect use, *i.e.*, the failure to remove the whole of the tea residues from the floor—the necessity of which has been repeatedly stressed since E. C. was first introduced. There are three definite variations to this :—

(1) Failure to wash the floor after treatment. The residues detached by the treatment have not been sterilised and bacterial growth will take place rapidly in the moist conditions set up. Unless acid E. C. is used

the alkaline solution may also have a bad effect on the leaf.

(2) Use of E. C. as a wash without attempting to *clean* the floor.

(3) Use of E. C. on a decayed or porous floor, where tea juice and bacteria have penetrated the floor structure and cannot be removed.

Strong warnings have been issued against these practices since E. C. was first advocated, but there is evidence that such warnings have been ignored in some instances, and that unsatisfactory results have been occasioned thereby.

Dealing with the above malpractices in turn, the first is difficult to justify, and can only have arisen through the use of E. C. without any realisation of its purpose. Thus on garden 11, E. C. solution was poured on the floor, and the leaf was actually put down in the solution. Blackened leaf naturally resulted through contact with the alkali in the solution.

The use of E. C. as a wash without attempting to clean the floor originates in the rather general idea that this reagent is intended to sterilise the floor. Actually, sterilisation cannot be effected unless the whole of the organic matter on the floor has been removed, and the figures given earlier in this report show that the amount of chlorine used is never sufficient to destroy the whole of the tea residues.

E. C. has been recommended solely as a means of assisting the removal of the insoluble juice residues from the floor, but this point has been occasionally overlooked. The original article on the use of E. C. (The Cleaning of Fermenting floors. Quarterly Journal, 1930, IV p. 165) states,

> ".....a direct attack on the *food* supply is the only satisfactory method of control. A floor which has been in use for some time is coated with a layer of dried juice which forms the *food* on which micro-

> organisms live. Of the various cleaning methods employed in the past, some made little or no attempt to remove this food supply, and others, although aiming at this requirement, failed since the reagents used were insufficiently vigorous in their action."

This should have made it sufficiently clear that complete cleaning of the floor was necessary. Nevertheless cases have been investigated where the solution was merely used as a wash. In one such instances scrapings from rolling and fermenting floors were sent for analysis after washing with E. C. The material was in the form of a foul-smelling, black paste with bacterial numbers :—

Rolling floor	...	2,600,000,000 bacteria per gram.
Fermenting floor	...	1,600,000,000 ,, ,,

It is obvious that had the treatment been correctly carried out, it would have been impossible to obtain material for analysis, and this point was communicated to the Manager concerned. Few instances of this type have actually been reported but there is reason to believe that washing with E. C. with the mistaken idea that the floor was being sterilised, was a not infrequent practise during 1931.

A caution was also issued against the use of E. C. on decayed and porous floors (Quarterly Journal, 1930, Part IV p. 169). The paragraph in question reads : "Floors are sometimes found where the surface layer of the cement is soft, crumbly, porous and badly pitted, due to the use of low grade cement, an excess of sand in the mixture, or frequently, to an excess of water which has 'drowned' the cement as a result of overworking the mixture while setting is taking place. In cases of this nature it is best to resurface the floor with pure cement, since a porous surface breeds micro-organisms in the spaces between the particles, and treatment is extremely difficult if not impossible."

This statement also appears to have been ignored in some quarters, and it is probable that most cases of dull infusions

following the treatment can be attributed to this cause, together with the use of E. C. as a wash, and not as a cleaning agent.

The fact remains that when used correctly and on floors which can be cleaned, E. C. gives satisfactory results in practise. It is advised that new and well laid floors be cleaned with E. C. from the commencement of their life, deposits of juice being continually removed before they have time to accumulate in quantity. Even the best floors may quickly accumulate sufficient dried juice to affect the teas. In a recent test a portion of a new Patent Stone floor, which had been in use for some three months only, was cleaned with E. C. and washed. Teas fermented on the cleaned floor were twice picked out by a taster for their brighter infusion and brisker liquor, in comparison with the normal outturn. The difference was sufficiently great to be apparent even to an untrained palate. A new floor is thus no guarantee that bacterial infection is being avoided, unless the floor is free from juice residues.

E. C. is not a substance which can be used in a haphazard manner, and its application should always be made under strict supervision.

It cannot be used with safety on old floors which are in poor condition since the primary requirement of the treatment is that the floor shall be completely cleaned. Where a floor cannot be cleaned, the alternative is to abandon it, and ferment off the floor, *e.g.*, on metal sheets or on wire racks covered with cloth.